Make-and-Take Demonstration: Renewable Energy and Clean Environmental Technologies

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ABSTRACT:

"Energy can neither be created nor destroyed," say our Science books, "but can only be transformed from one form to another. Humankind and nature have been engaged with this transformation since life began on this planet. The world's primary energy consumption increased to 14 terrawatt-years per year, almost 50 times the pre-industrial level of about 0.3 terrawatt-years per year. The world population grew about five times in the same period. If we analyze the energy challenges of today, running out of resources does not emerge as the major worry. Yet there is another worry, *greenhouse gas (GHG) emissions,* that is becoming more insidious and urgent. Are there ways to control the greenhouse gas emissions without harming the environment? What are the energy technologies that emit no or minimal CO_2 (Carbon di-oxide)? Are there technologies and policies that help to minimize energy demand and consumption? These questions along with a few corollaries shape the theme for discussion on *energy* and its associated *environmental* causes for the sustainable life on our planet "*earth".* Many new energy saving technologies are now emerging. Light emitting diodes (LED) that can replace incandescent bulbs, electric cars and hybrids that substitute for petrol (gasoline) engines, green building technology, electricity production using inexhaustible and renewable energies like solar photovoltaics, wind, hydropower, nuclear, geo and ocean thermal sources. Hydrogen offers the possibility, if harnessed by using clean and safe methods, of moving us toward a cleaner and more secure energy future. Moreover, advancement in the discovery of *nanotechnology becomes a working force and catalyzes the growth of clean technology research.* This Make-and-Take demonstration will provide firsthand information about energy conversion processes, emerging renewable energy and clean environment technologies and their potential real time applications for sustainable life on our fragile planet EARTH.

BIO-SKETCH OF DR. SESHA S. SRINIVASAN

Dr. Sesha Srinivasan, Assistant Professor of Physics, Tuskegee University, Alabama, USA, having more than a decade of research experience in the interdisciplinary areas of Solid State and Condensed Matter Physics, Inorganic Chemistry, Chemical and Materials Science Engineering. His PhD problem focuses on the development various rare-earth, transition metals and intermetallic alloys, composites, nanoparticles and complex hydrides for reversible hydrogen storage applications. Dr. Srinivasan and his Ph.D advisor, Professor O.N. Srivastava (BHU, Varanasi), has successfully converted a 4-stroke, 100 cc Honda motorcycle to run on Hydrogen gas, which was delivered from the on-board metal hydride canister. After his PhD completion, Dr. Srinivasan joined the research team of Professor Craig Jensen as a Post Doctoral Fellow in the Department of (Inorganic) Chemistry, University of Hawaii, Honolulu, Hawaii, USA. He and his Post Doctoral advisor has extensively collaborated with Scientists around the world for the hydrogen storage on light weight complex hydrides which were funded by the US Department of Energy (DOE) and WE-NET, Japan. After two years at University of Hawaii, he has joined as a Research Scientist, Clean Energy Research Center (CERC) at University of South Florida under the leaderships of Professor Elias Stefanakos and Professor Yogi Goswami. He has established state-of-the-art research

laboratory at the CERC and supervised several graduate and undergraduate students for their Masters and PhD dissertations. He has also served as an Associate Director of Florida Energy Systems Consortium (FESC) at USF to co-ordinate number of research projects on clean energy and environment, which was funded by the State Energy Office Florida ($9M grant). In his current position at Tuskegee University, Dr. Srinivasan was awarded many research grants, worth of $0.5M from both federal (DOE, ONR) and private (BP-Oil Spill, QuantumSphere Inc.) funding sources. He has recently awarded with two US patents Hydrogen storage nano-materials' development and its methodology. He published six book chapters and review articles, more than 50 journal publications and many more peer-reviewed conference proceedings. Dr. Srinivasan has served as a reviewer in the panel review committee of the National Science Foundation (NSF), SMART and NDSEG panels of ASEE, ad-hoc merit review committee of US Department of Energy and panelist for Qatar National Research Fund (QNRF). He is currently on the Editorial board of De Gruyter Open for Physics, SciKnow journal publications and Datasets International Journal on Materials Science. Dr. Sesha Srinivasan can be reached at srinivas@mytu.tuskegee.edu.

Make-and-Take Demonstration: Renewable Energy Technologies

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University of South Alabama, Mobile, AL
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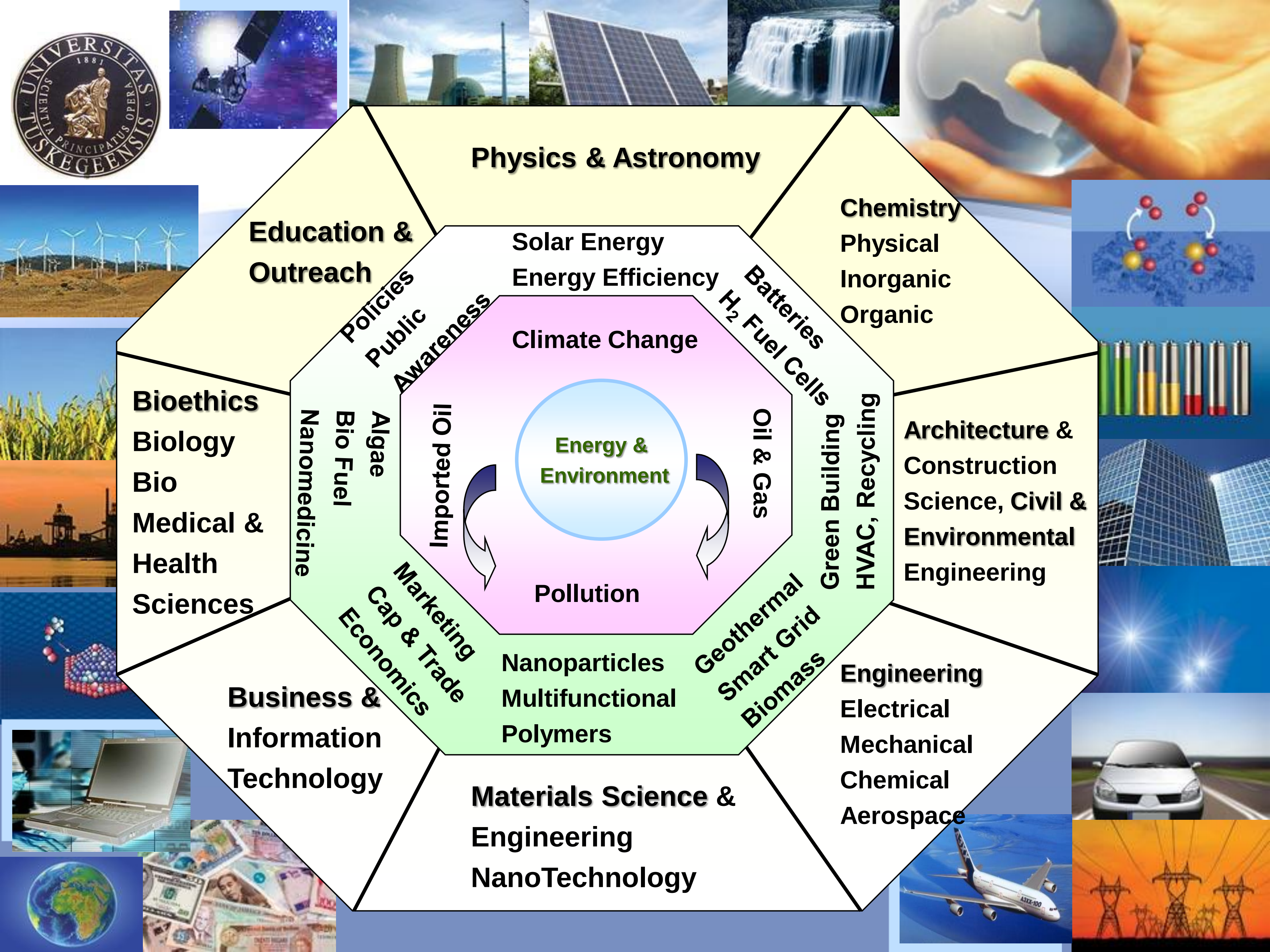
Energy and Environment

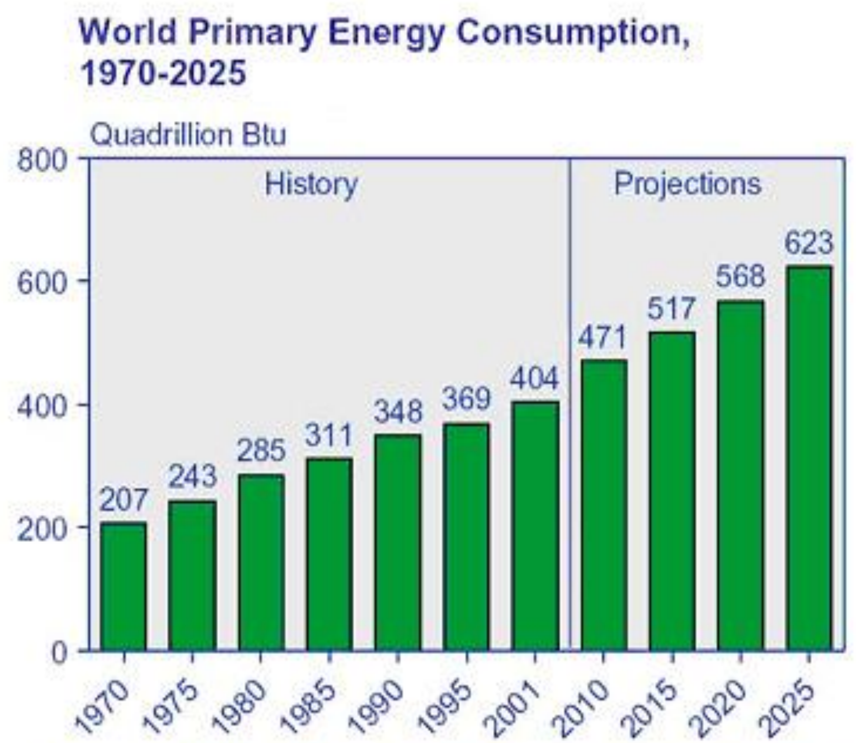
"So we have a choice to make. We can remain one of the world's leading importers of foreign oil, or we can make the investments that would allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stop it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for lasting prosperity."

-**President Obama, March 19, 2009**

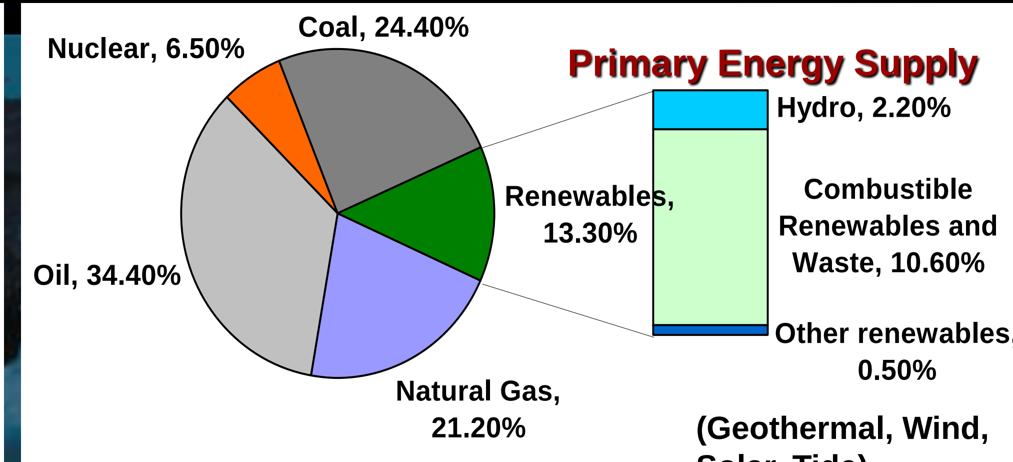


Physics & Astronomy
Chemistry
Physical
Inorganic
Organic
Architecture & Construction Science, Civil & Environmental Engineering
Engineering
Electrical
Mechanical
Chemical
Aerospace
Materials Science & Engineering
NanoTechnology
Business & Information Technology
Bioethics
Biology
Bio
Medical & Health Sciences
Education & Outreach
Solar Energy
Energy Efficiency
Batteries
H_2 Fuel Cells
Green Building
HVAC, Recycling
Geothermal
Smart Grid
Biomass
Nanoparticles
Multifunctional
Polymers
Marketing
Cap & Trade
Economics
Nanomedicine
Bio Fuel
Algae
Policies
Public
Awareness
Climate Change
Imported Oil
Oil & Gas
Pollution
Energy & Environment
UNIVERSITAS TUSKEGEENSIS
1881
SCIENTIA PRINCIPATUS OPERA

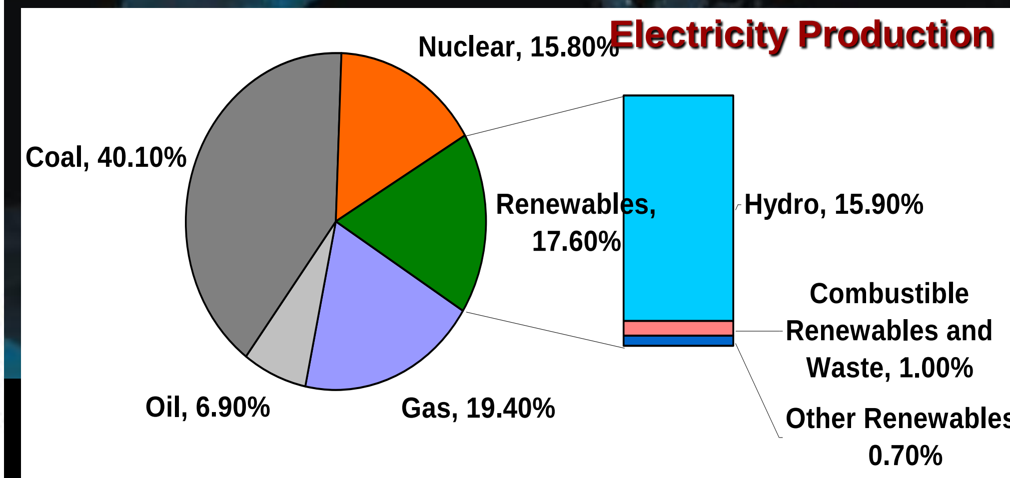
World Energy Consumption since 1970 projected to 2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2004).



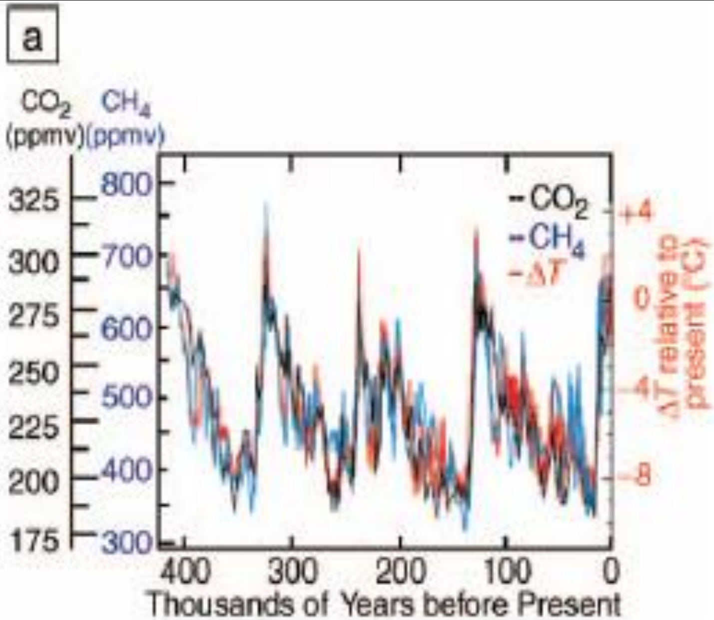
Totals in graphs might not add up due to rounding.



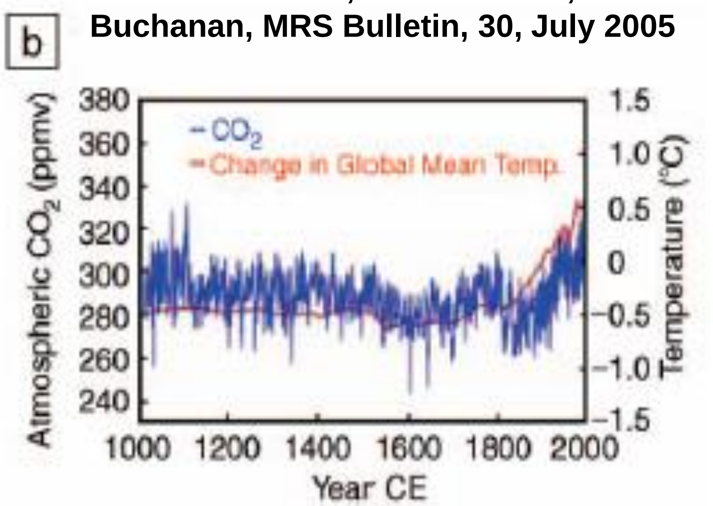
IEA Renewables Information (2005)

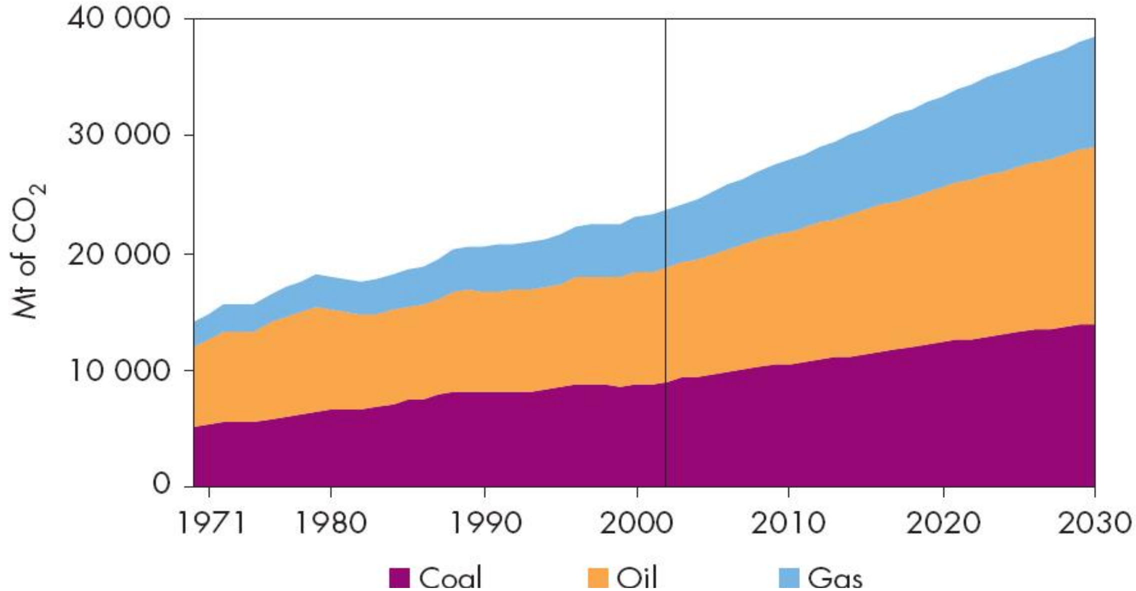
Is Global Warming Real?

World Energy Related CO_2 Emissions by Fuel

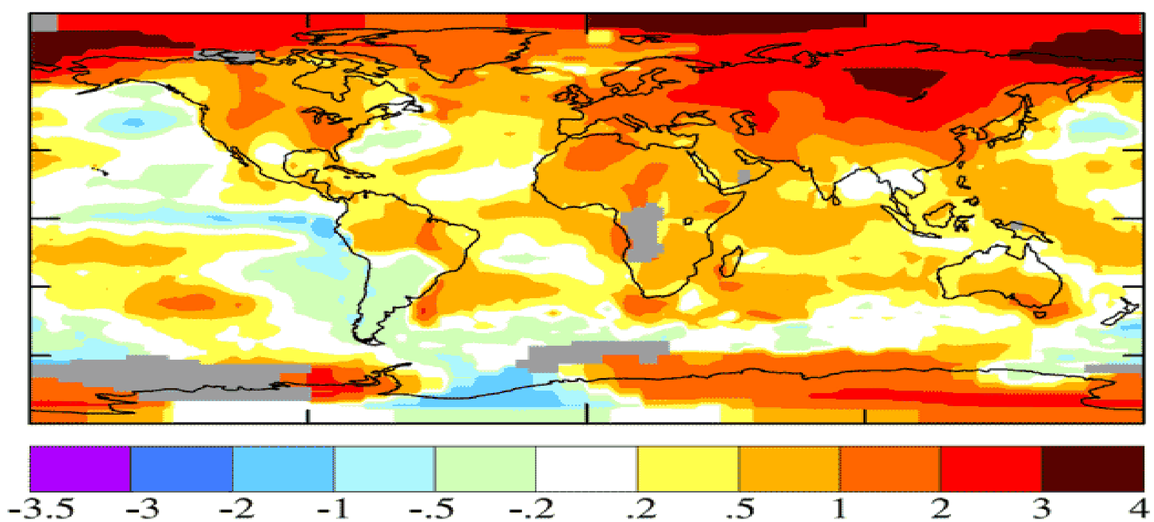


MS. Dresselhaus, GW. Crabtree, MV. Buchanan, MRS Bulletin, 30, July 2005

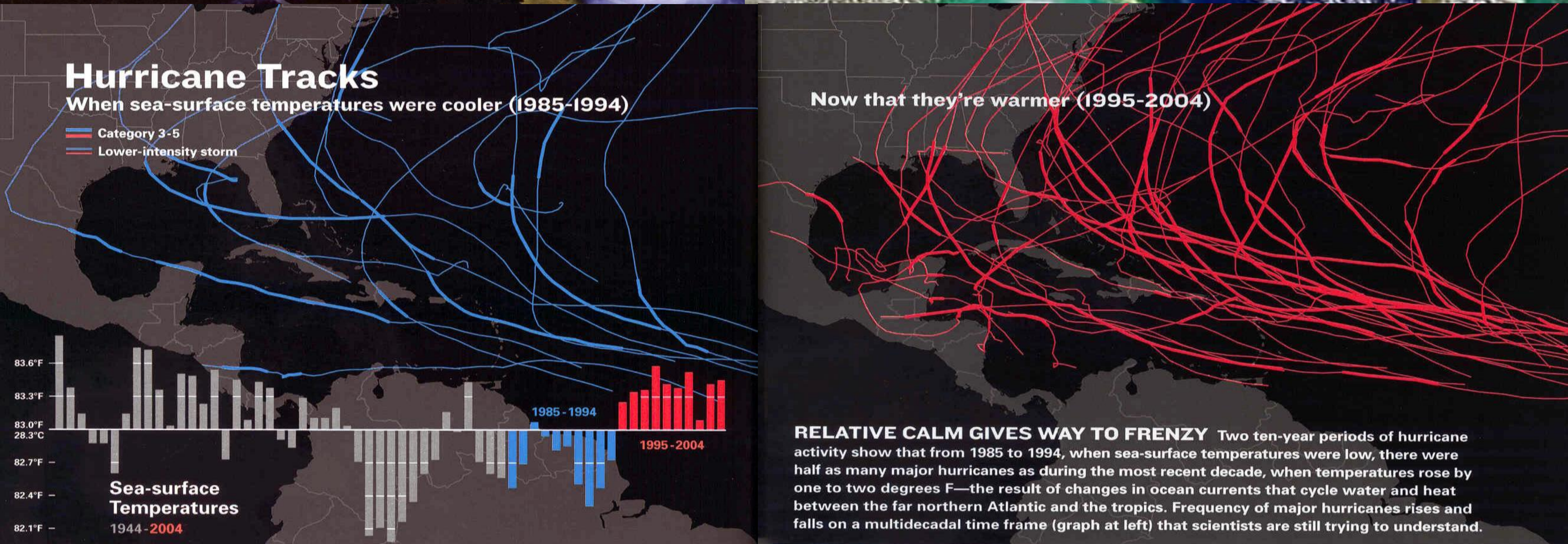




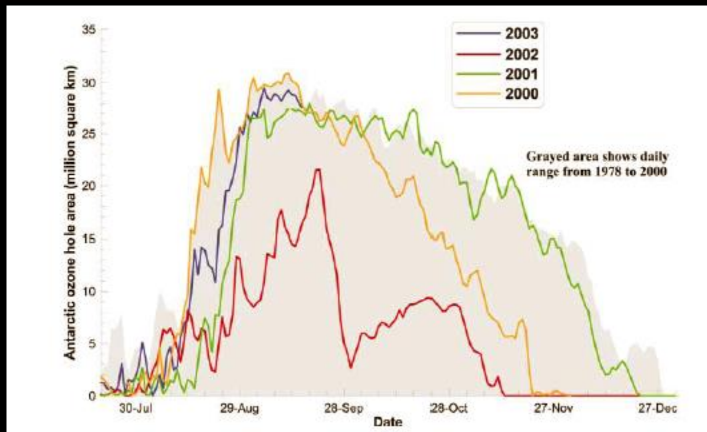
Global Temperature Changes 2007

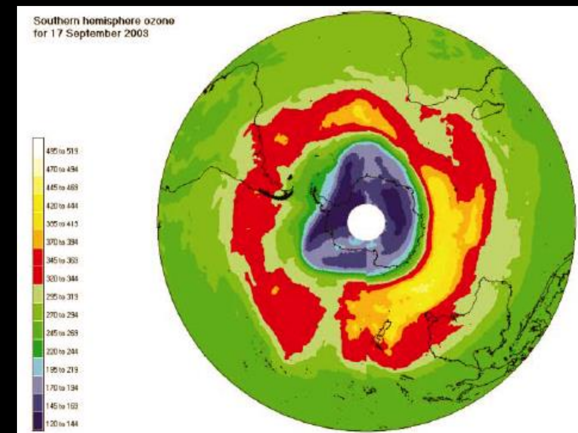


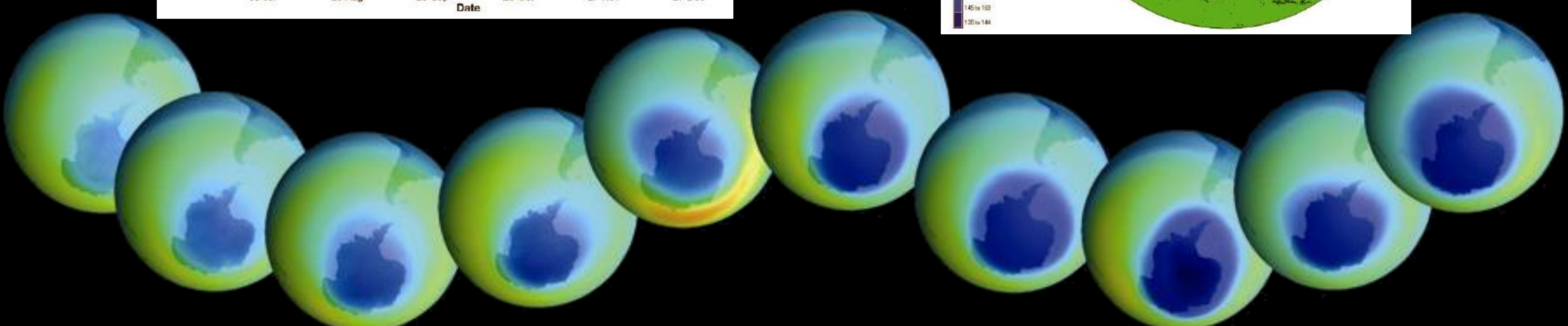
Effects of Global Warming



Ozone Depletion



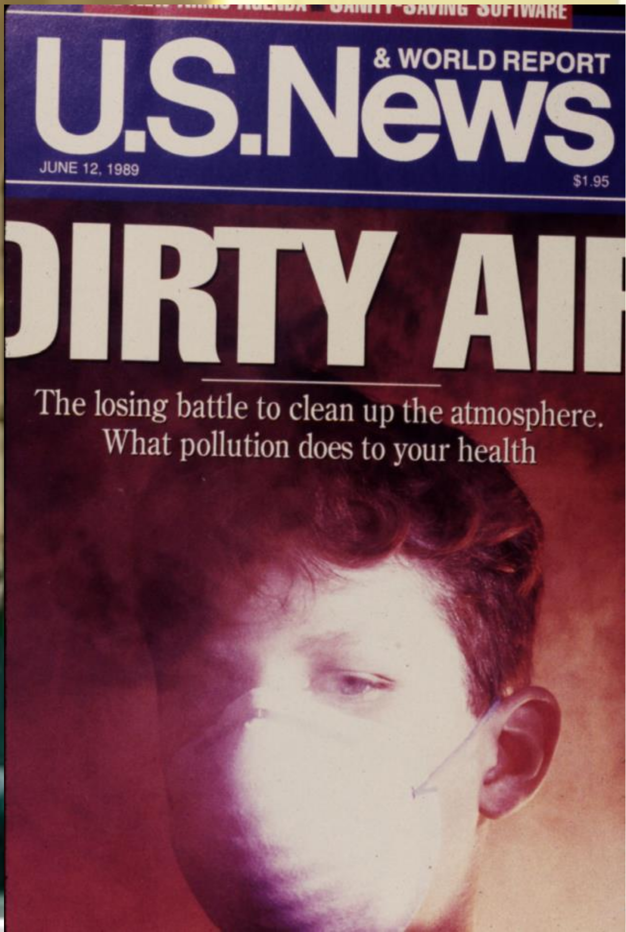


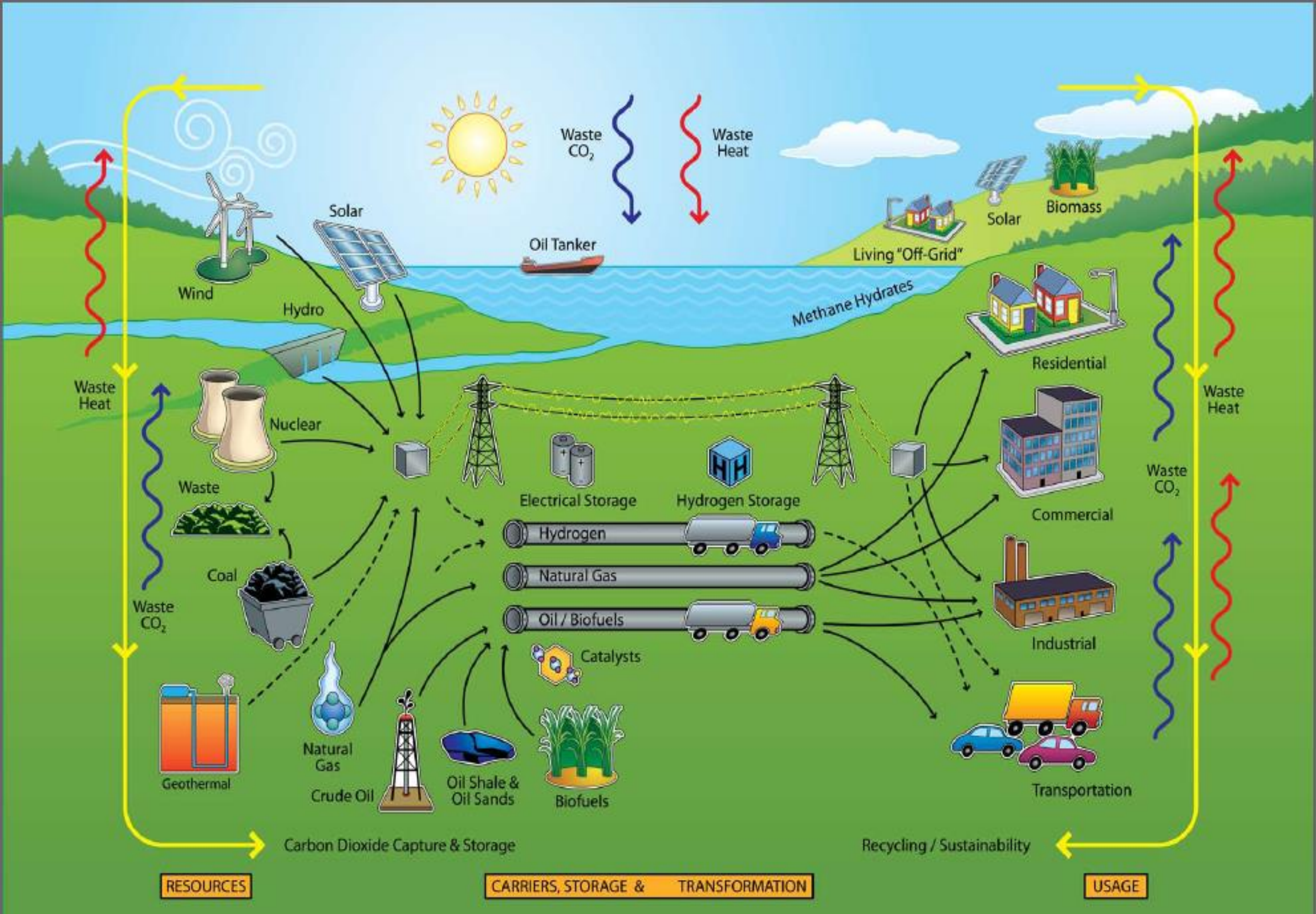


Growth of the Antarctic ozone hole over 20 years, as observed by the satellite

Darkest blue areas represent regions of maximum ozone depletion.

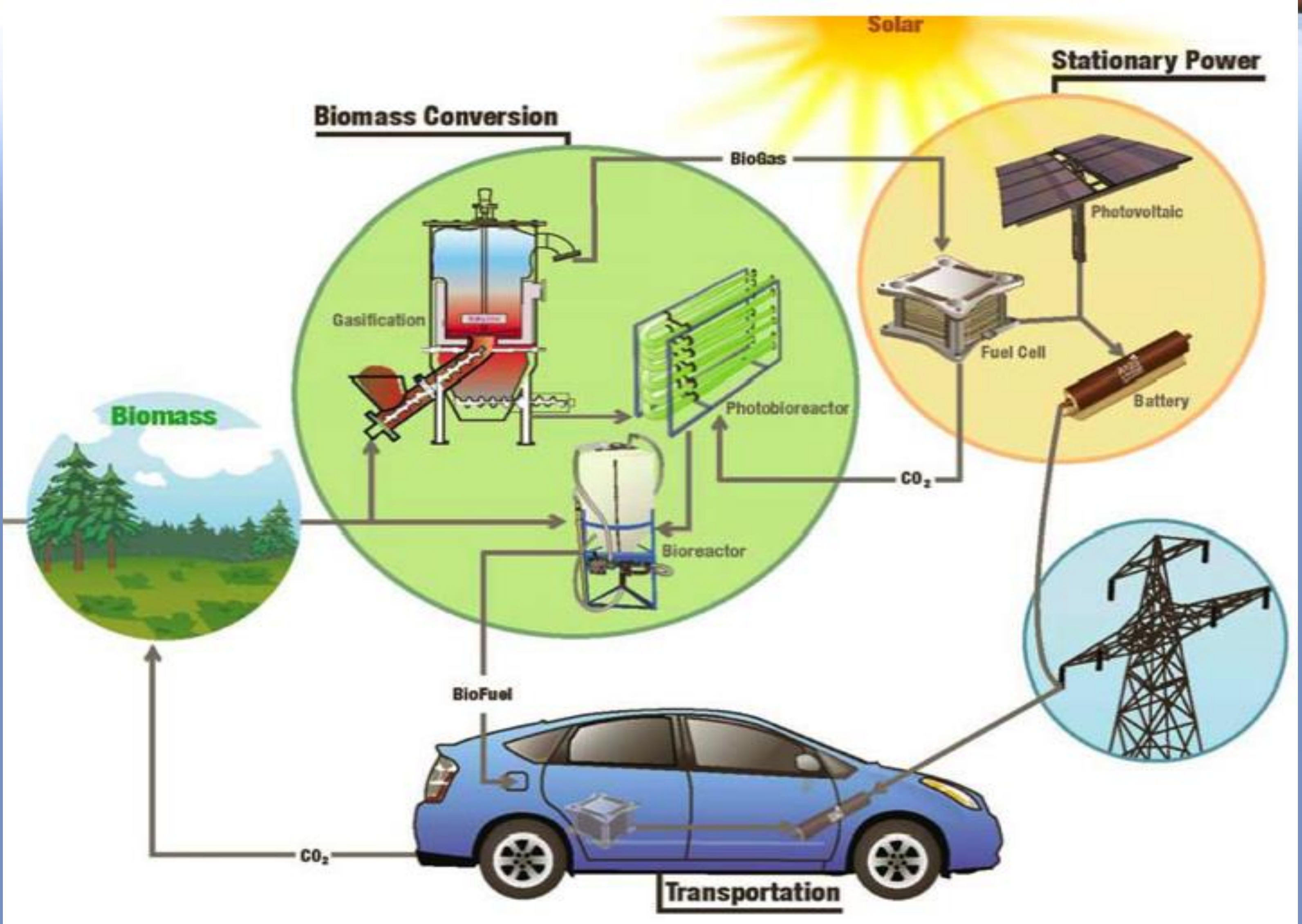
Air Pollution



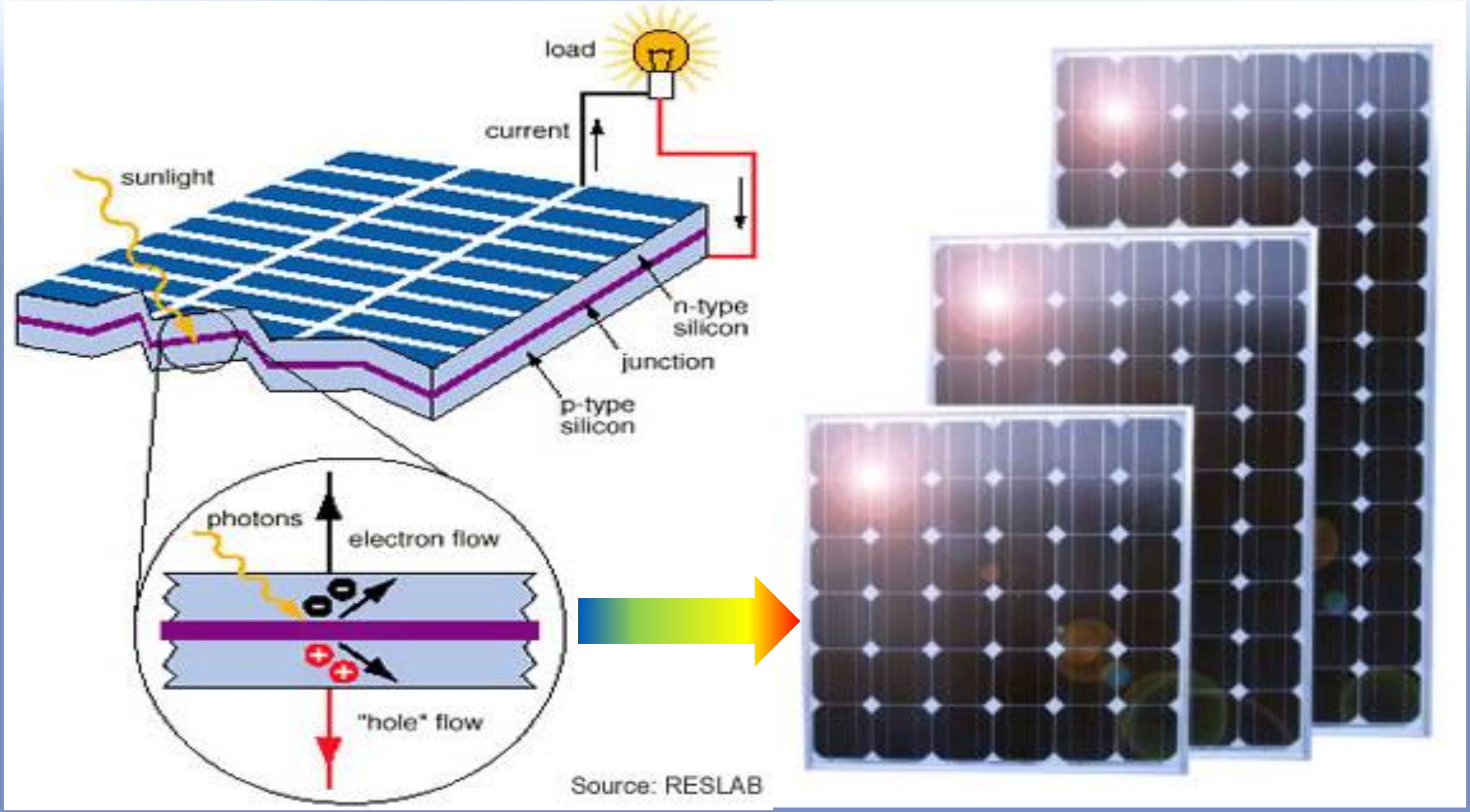


Green Energy Technologies

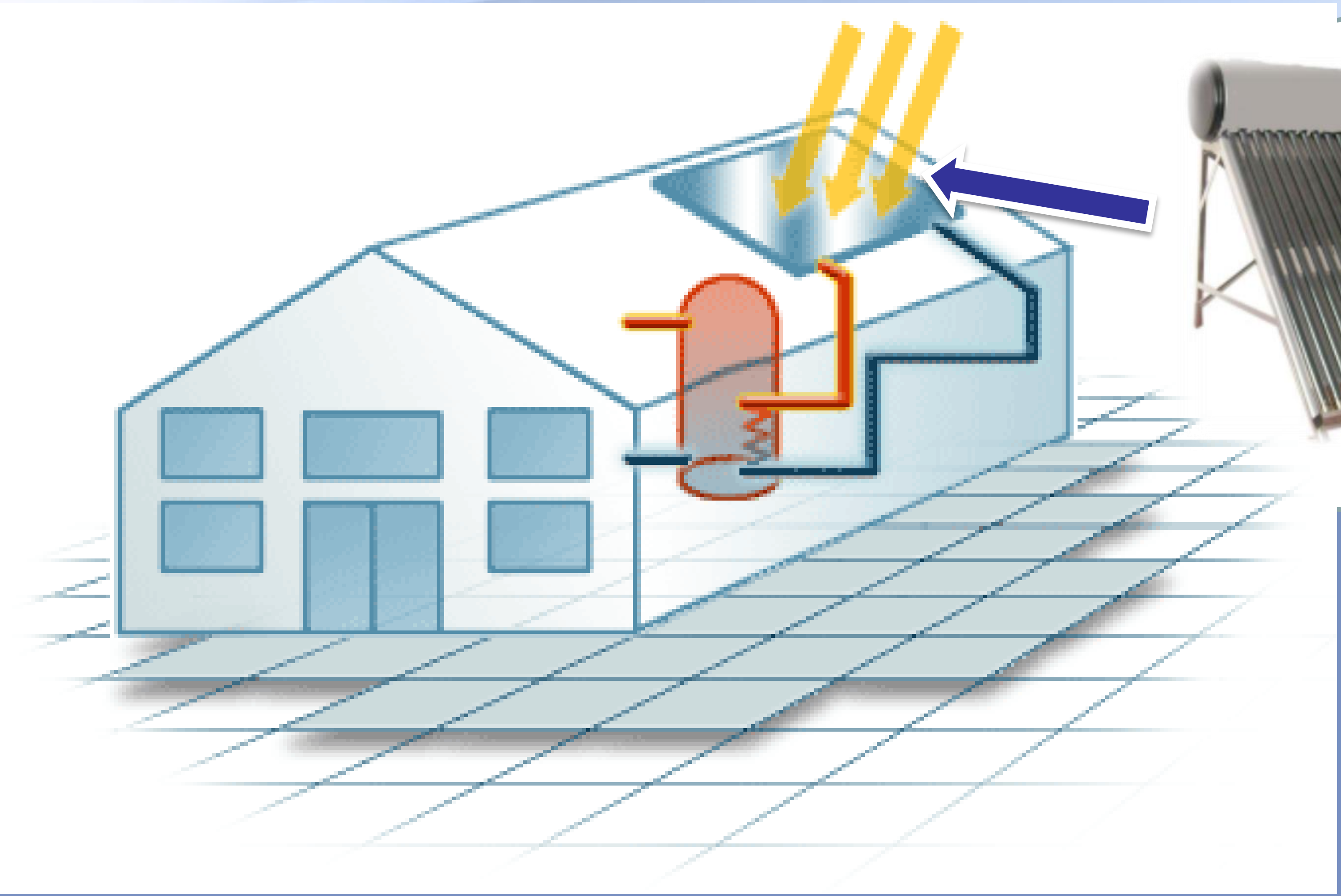
Green Energy System Design



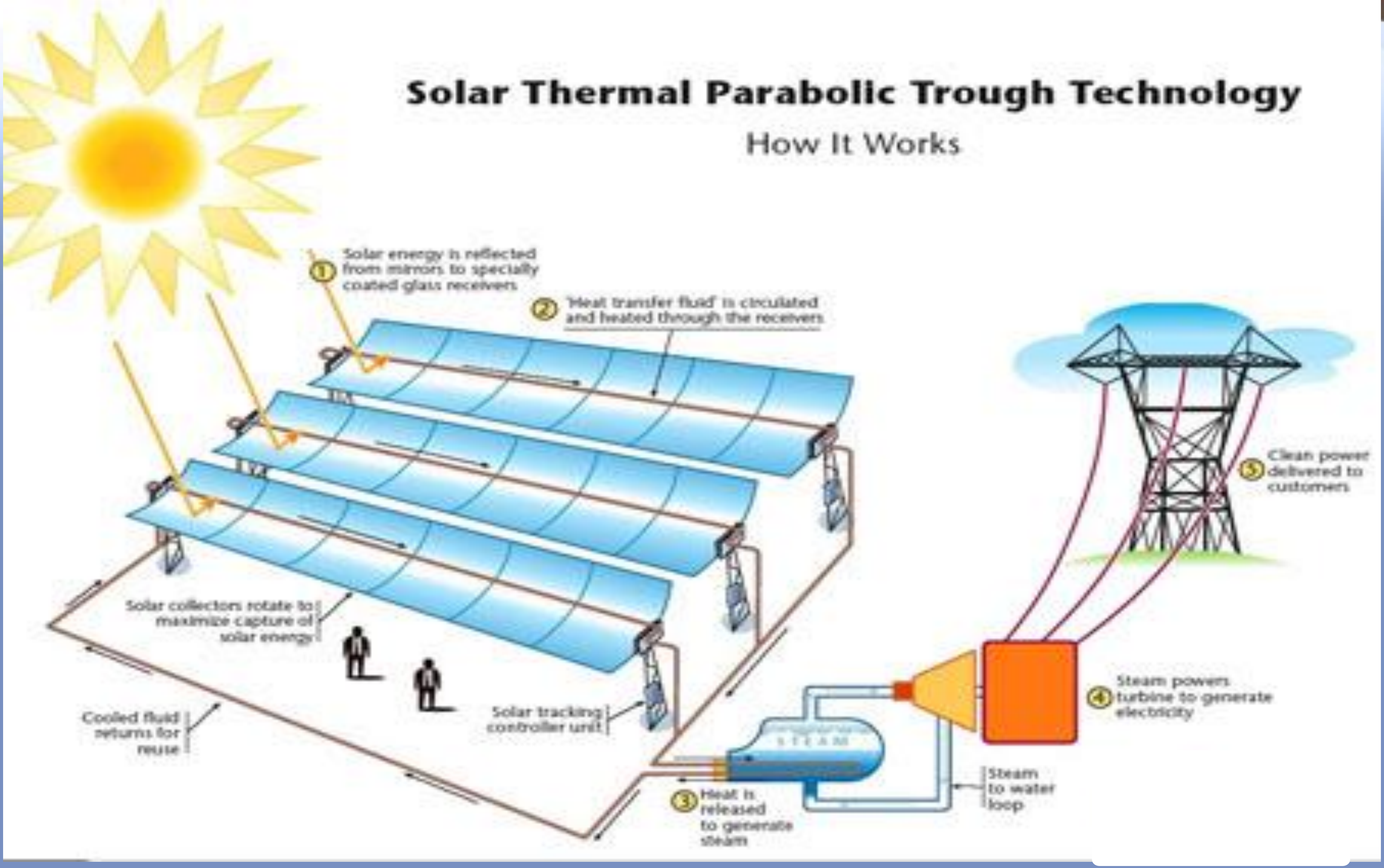
Solar Photovoltaics (PV)



Solar Hot Water



Solar Thermal Power



Smart Grid


The Smart Grid Can Deliver
Market
BENEFITS
• Enhanced energy security
• Reduced greenhouse gases
• Improved urban air quality
• Increased grid asset utilization
"Valley Filling"
(Energy for PHEVs)
hours of day
PHEV
Urban Emissions
Electricity Sales
Infrastructure Requirements
Utility Rates

Road Transportation

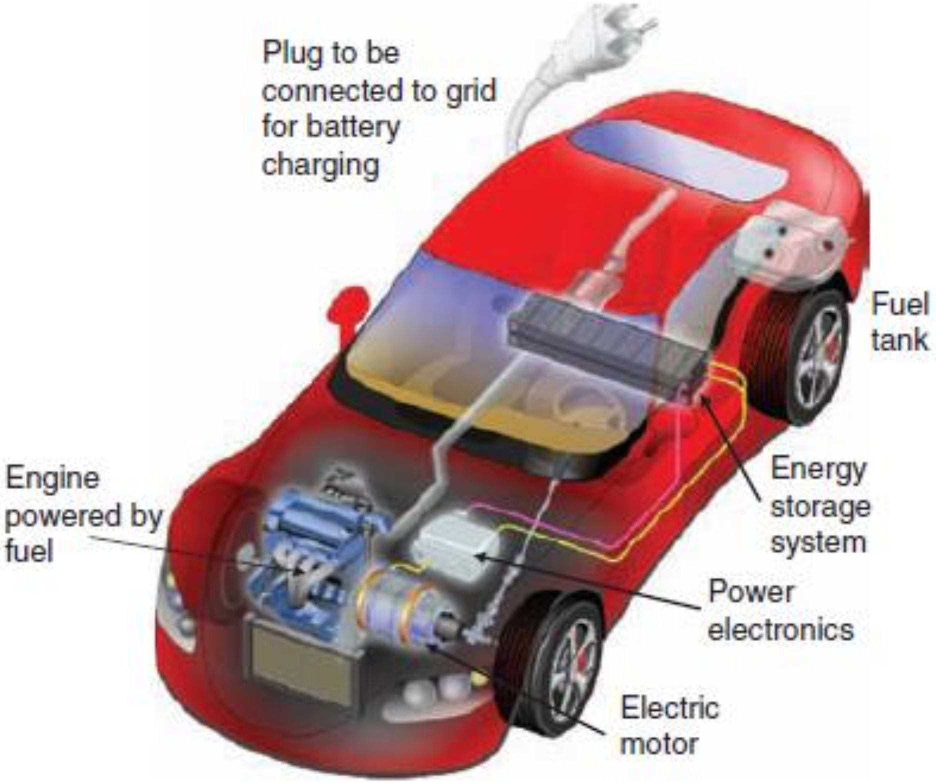
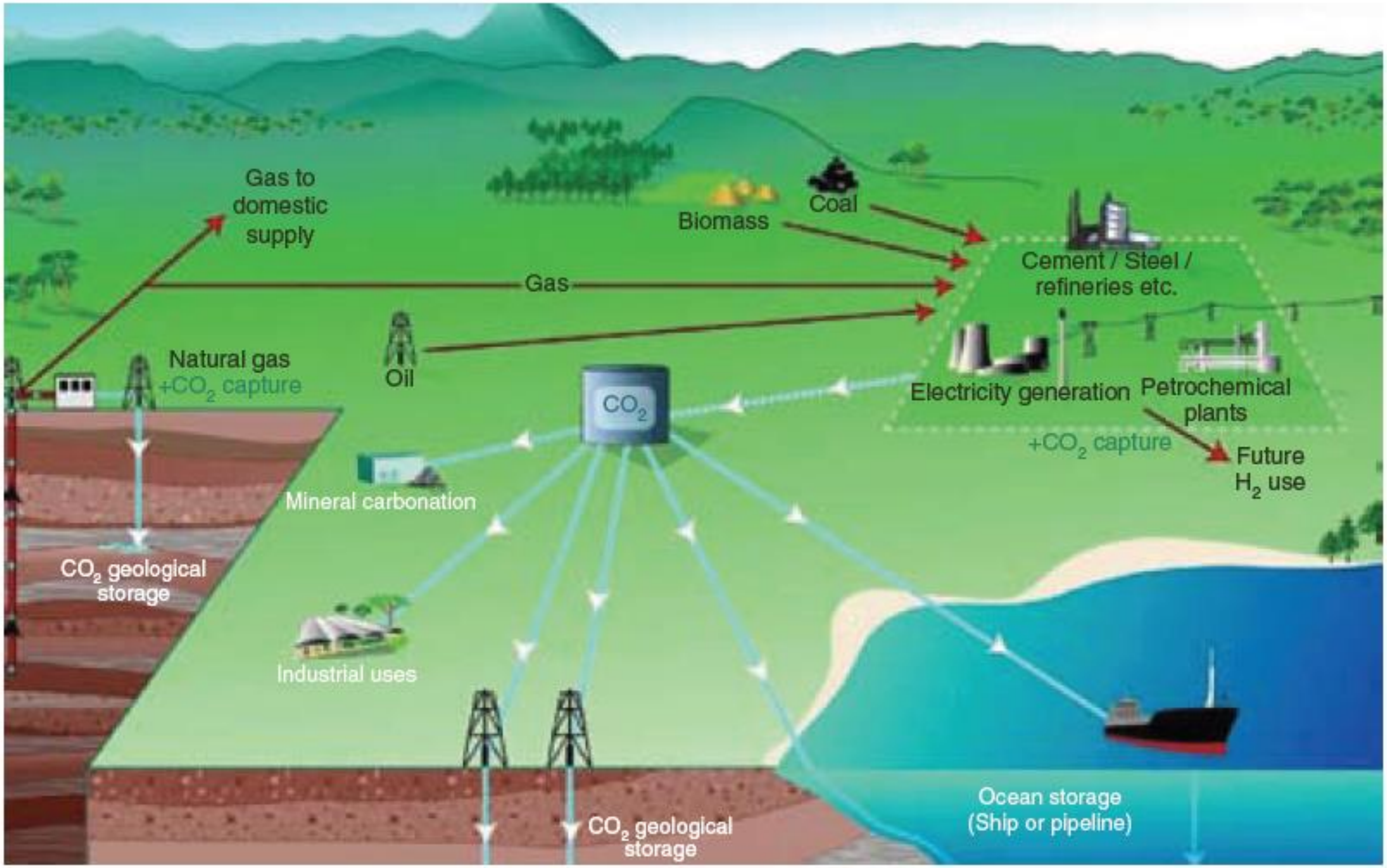


Figure 4. Components in a plug-in hybrid vehicle. (Without the plug and the on-board charger, the components represent a hybrid electric vehicle.)

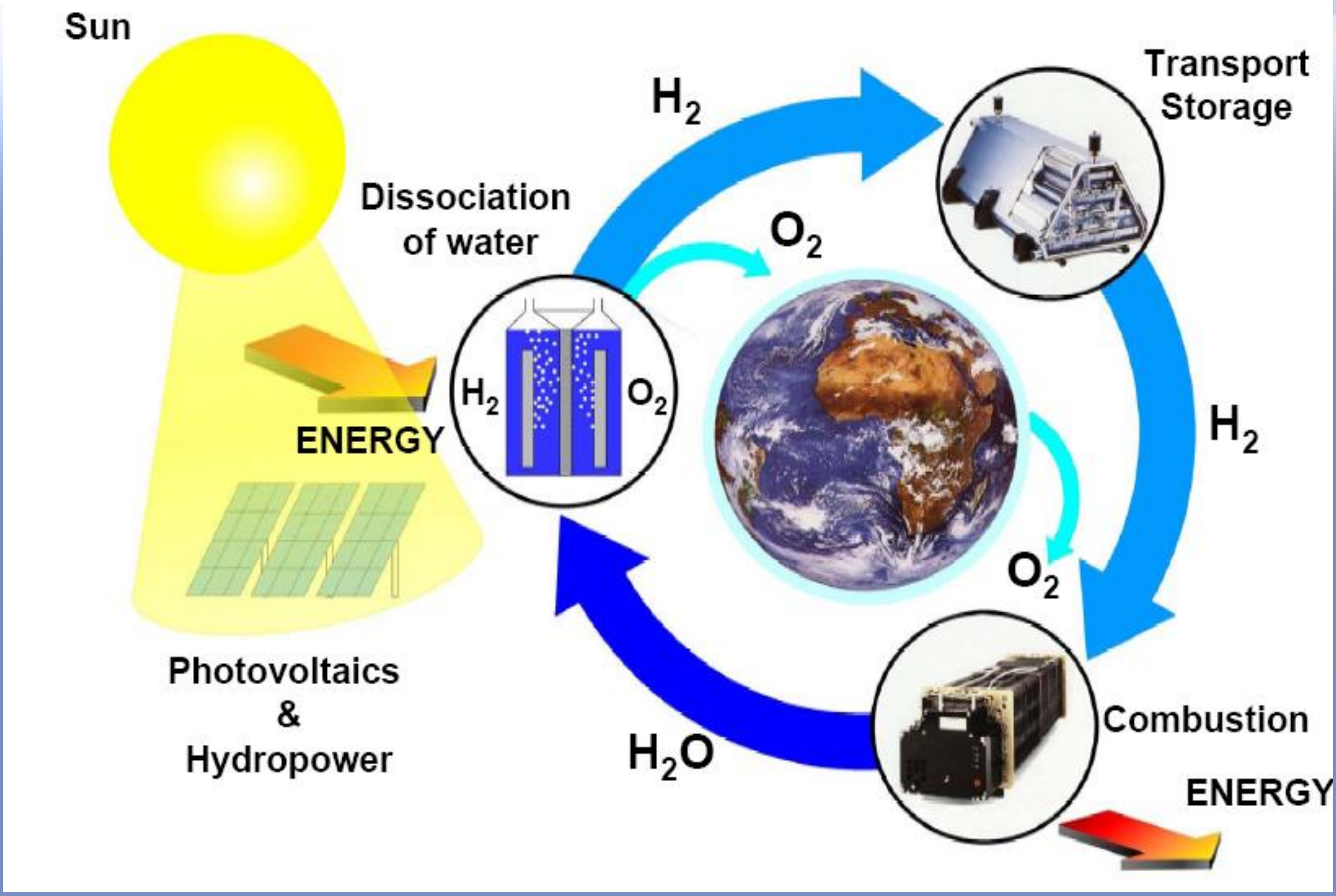
Energy Efficiency of a Vehicle could be improved by:

- Light weighting the vehicle structure and powertrain
- Improving the efficiency of the internal combustion engine
- Reducing tire rolling resistance and
- Hybridization.

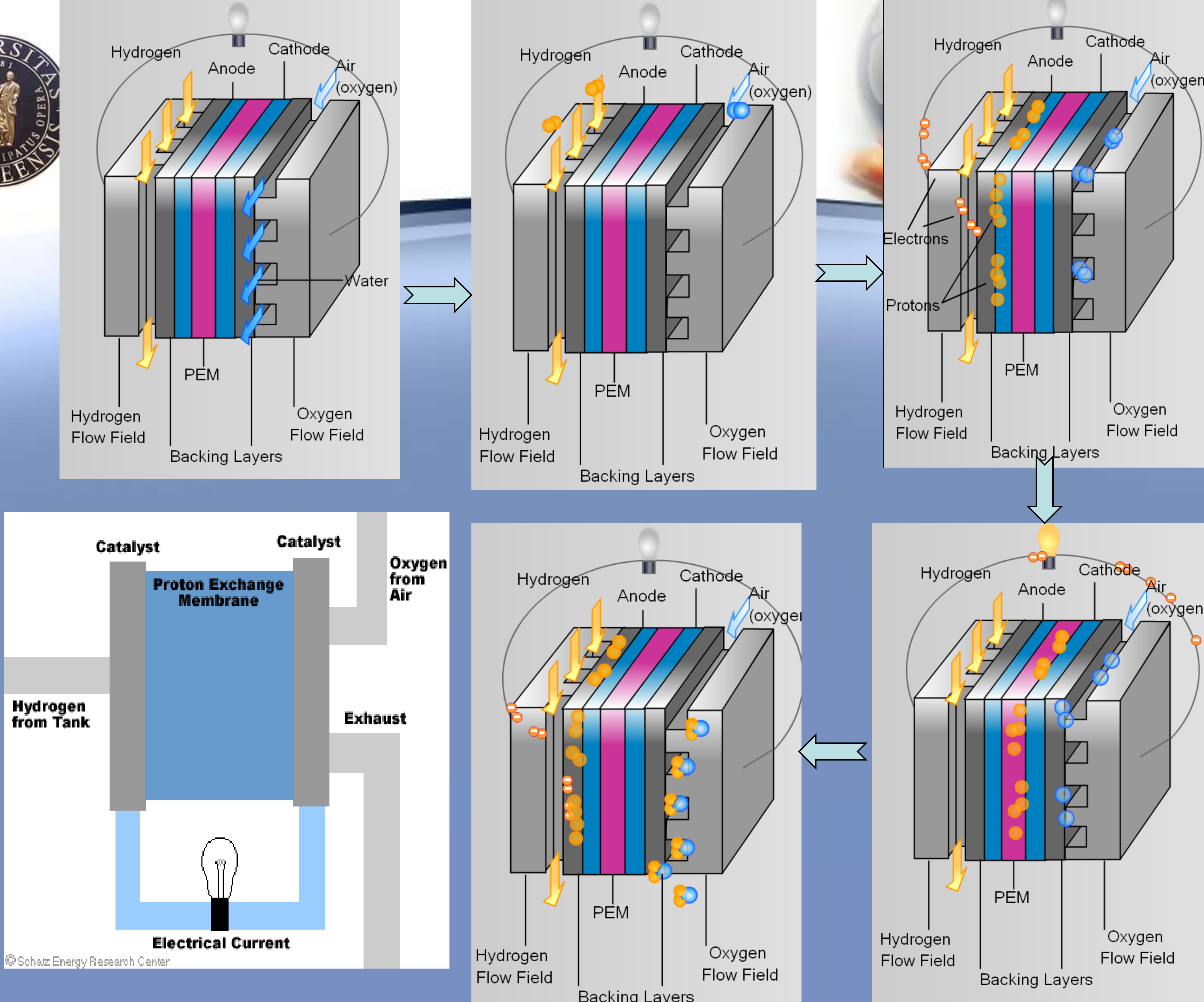
CO_2 Capture and Storage



Hydrogen cycle-Source Regeneration



HOW DOES A FUEL CELL WORK?



Volume Comparisons for 4 kg Vehicular H_2 Storage

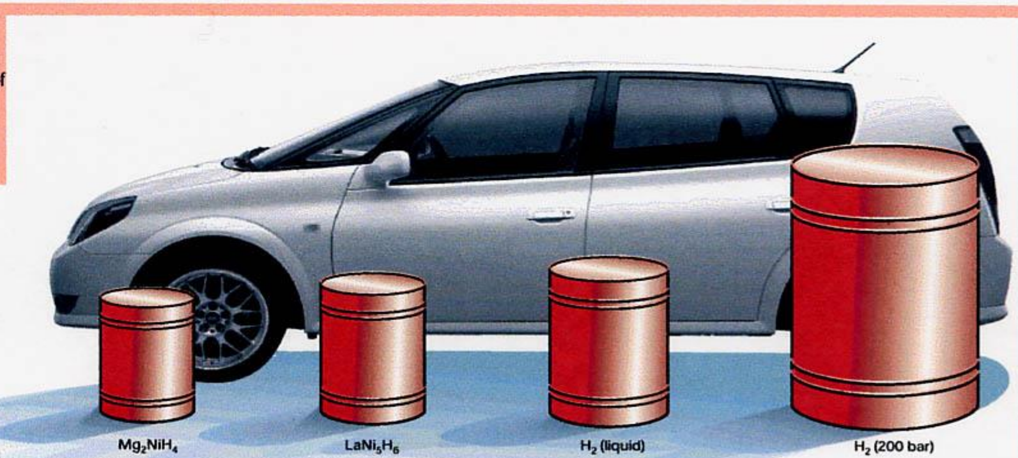


Figure 1 Volume of 4 kg of hydrogen compacted in different ways, with size relative to the size of a car. (Image of car courtesy of Toyota press information, 33rd Tokyo Motor Show, 1999.)

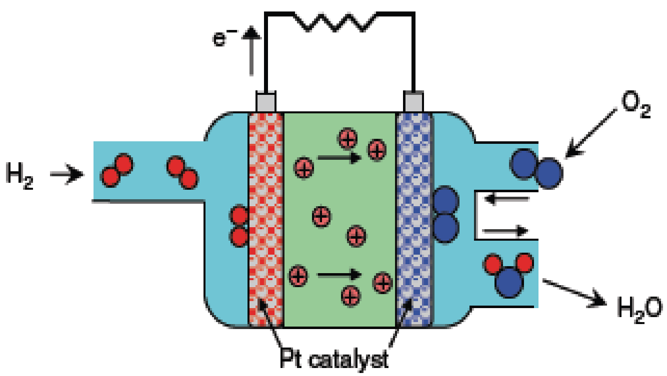
Schlapbach & Züttel, Nature, 15 Nov. 2001

Solid Hydrogen Storage

10 kg MH-based H_2 Refueling Station

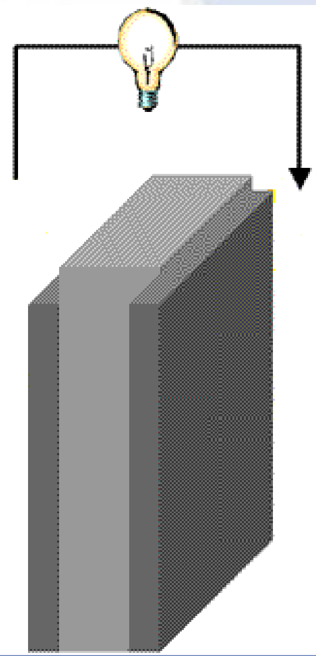
250 cc H_2-ICE Powered Scooter

Fuel Cells - Applications



$H_2 \rightarrow 2H^+ + 2e^-$
hydrogen oxidation

$4H^+ + 4e^- + O_2 \rightarrow 2H_2O$
oxygen reduction



Fuel Cell

Solid State Lighting

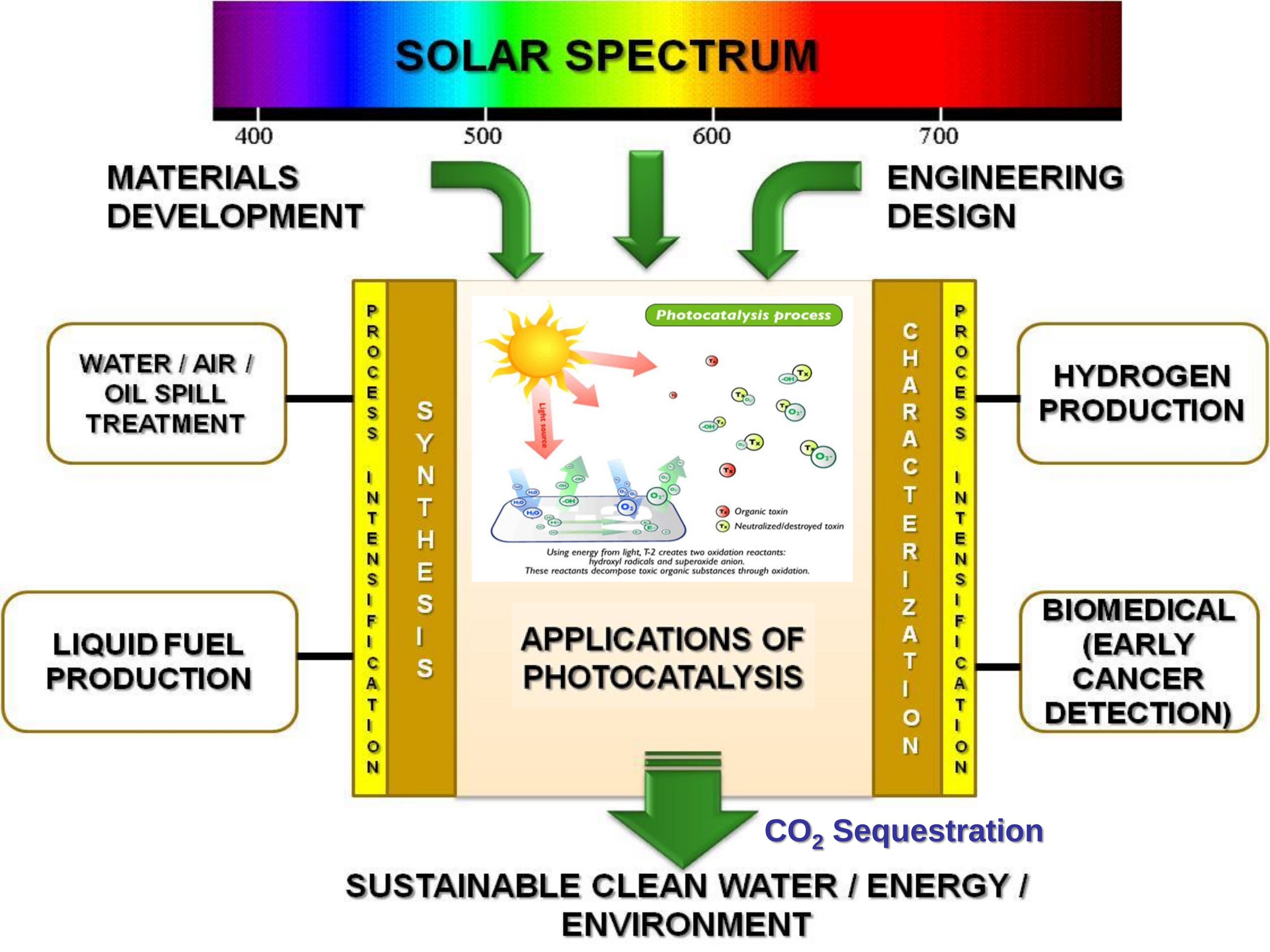
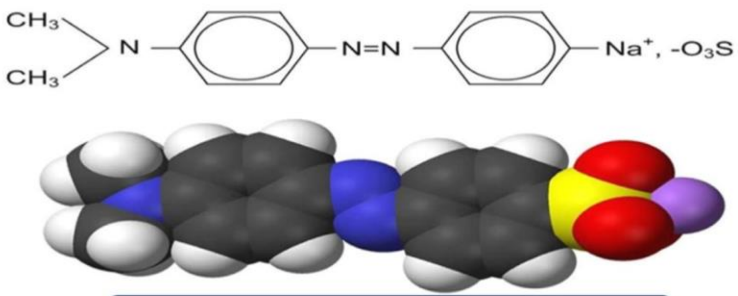
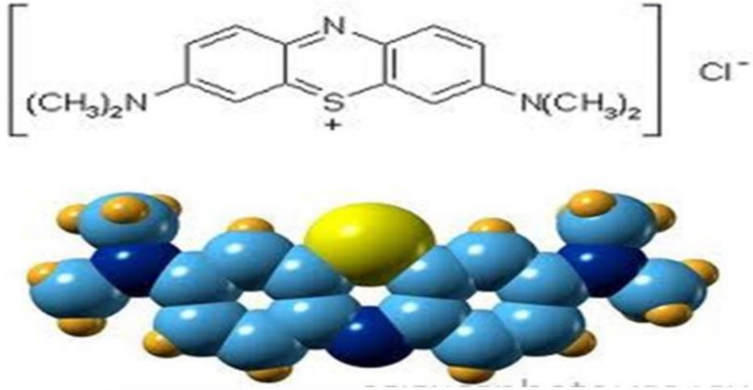

SOLAR SPECTRUM
400
500
600
700
MATERIALS DEVELOPMENT
ENGINEERING DESIGN
WATER / AIR / OIL SPILL TREATMENT
LIQUID FUEL PRODUCTION
HYDROGEN PRODUCTION
BIOMEDICAL (EARLY CANCER DETECTION)
PROCESS INTENSIFICATION
SYNTHESIS
CHARACTERIZATION
PROCESS INTENSIFICATION
Photocatalysis process
Light source
Organic toxin
Neutralized/destroyed toxin
Using energy from light, T-2 creates two oxidation reactants: hydroxyl radicals and superoxide anion.
These reactants decompose toxic organic substances through oxidation.
APPLICATIONS OF PHOTOCATALYSIS
CO_2 Sequestration
SUSTAINABLE CLEAN WATER / ENERGY / ENVIRONMENT

Photo-Oxidation of Organic Contaminants in Aqueous H_2O

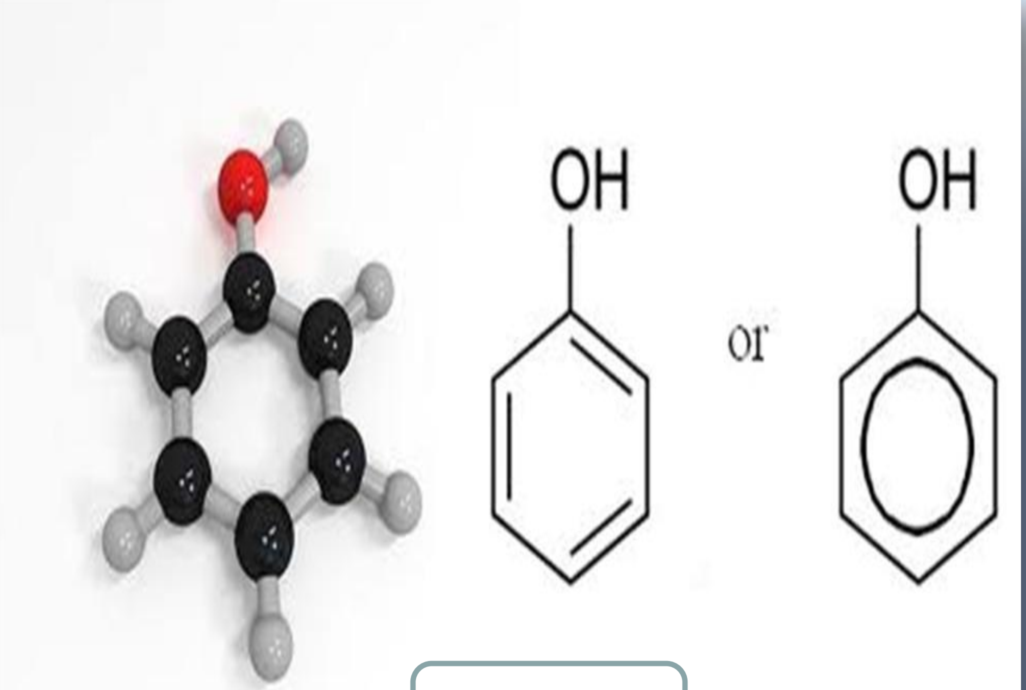
MODEL CONTAMINANTS



Methyl Orange

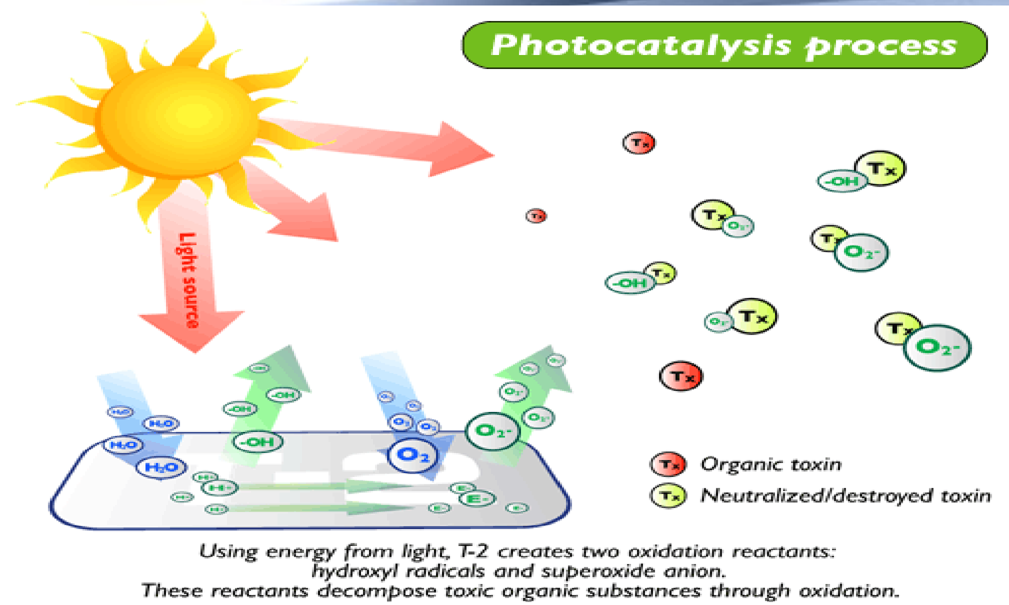


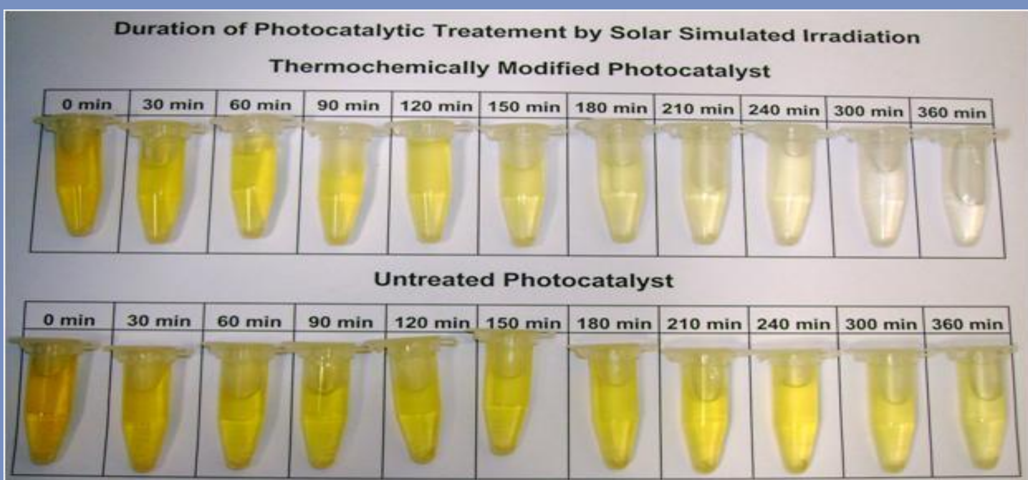
Methylene Blue

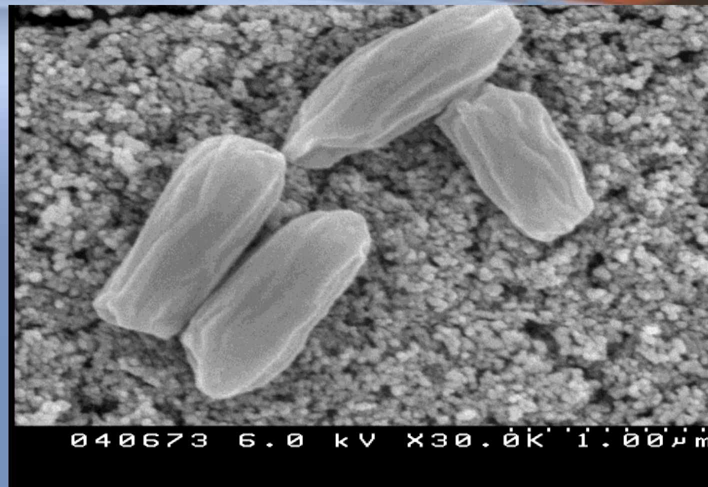


Phenol

Air / Water Purification by Photocatalysis

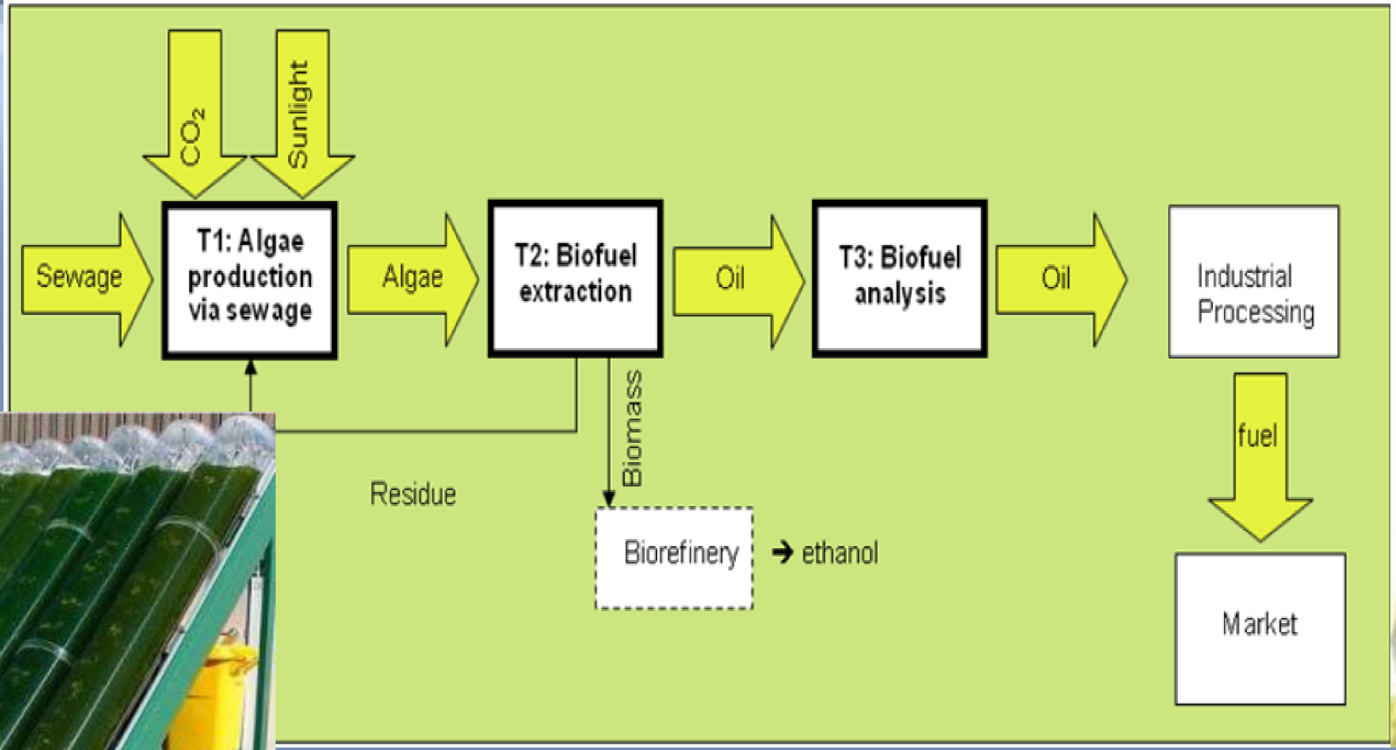




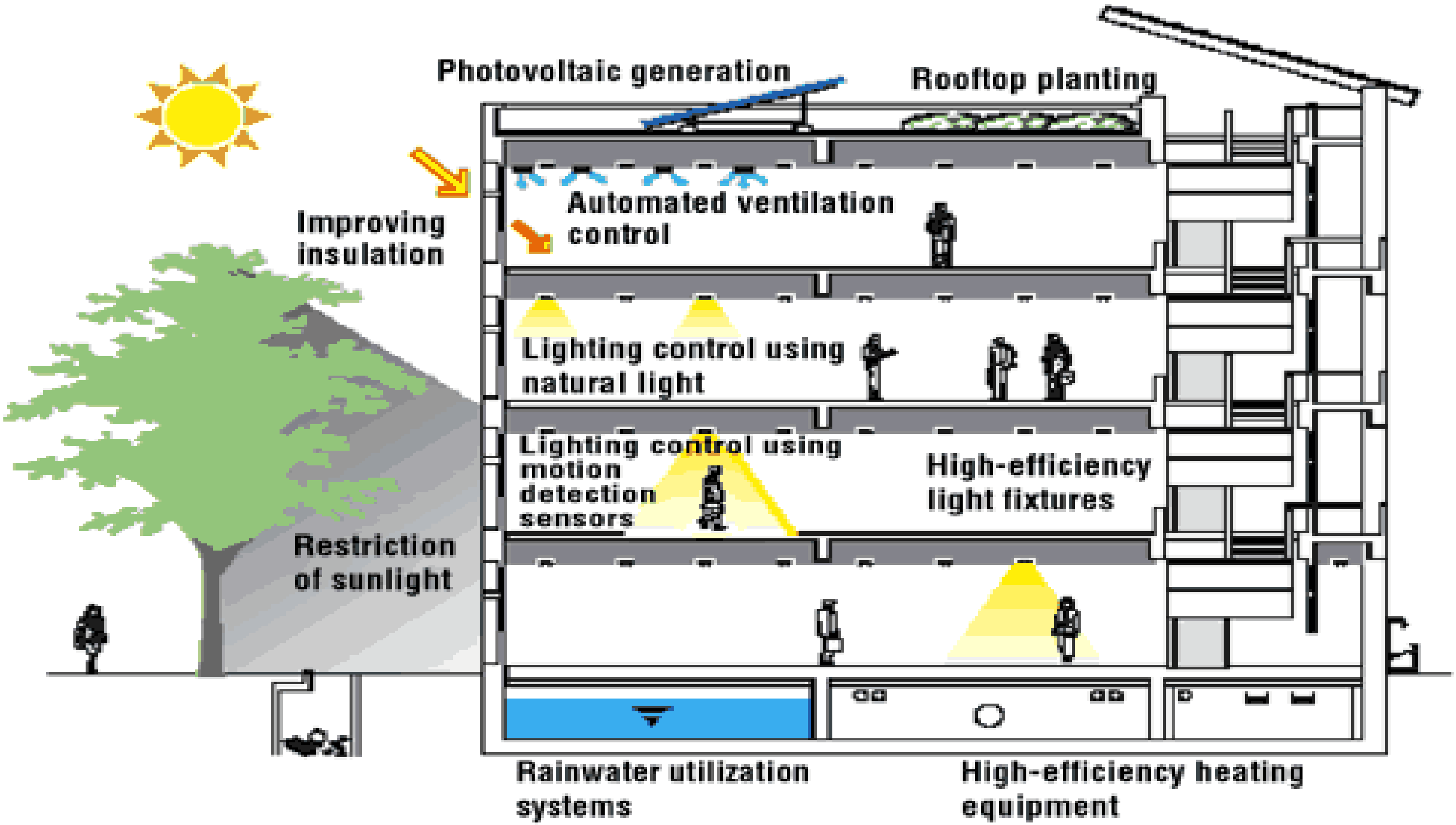


Bacterial Destruction using TiO_2 photocatalyst

Sunlight to Biofuel



Green Buildings to Increase Energy Efficiency



Conceptual Drawing of Green Building

Three “R”s for Energy Conservation

Reuse, Reduce, Recycle

tenthingstodo

Want to do something to help stop global warming?
Here are 10 simple things you can do and how much carbon dioxide you'll save doing them.

Change a light

Replacing one regular light bulb with a compact fluorescent light bulb will save 150 pounds of carbon dioxide a year.

Drive less

Walk, bike, carpool or take mass transit more often. You'll save one pound of carbon dioxide for every mile you don't drive!

Recycle more

You can save 2,400 pounds of carbon dioxide per year by recycling just half of your household waste.

Check your tires

Keeping your tires inflated properly can improve gas mileage by more than 3%.
Every gallon of gasoline saved keeps 20 pounds of carbon dioxide out of the atmosphere!

Use less hot water

It takes a lot of energy to heat water. Use less hot water by installing a low flow showerhead (350 pounds of CO_2 saved per year) and washing your clothes in cold or warm water (500 pounds saved per year).

Avoid products with a lot of packaging

You can save 1,200 pounds of carbon dioxide if you cut down your garbage by 10%.

Adjust your thermostat

Moving your thermostat just 2 degrees in winter and up 2 degrees in summer
You could save about 2,000 pounds of carbon dioxide a year with this simple adjustment.

Plant a tree

A single tree will absorb one ton of carbon dioxide over its lifetime.

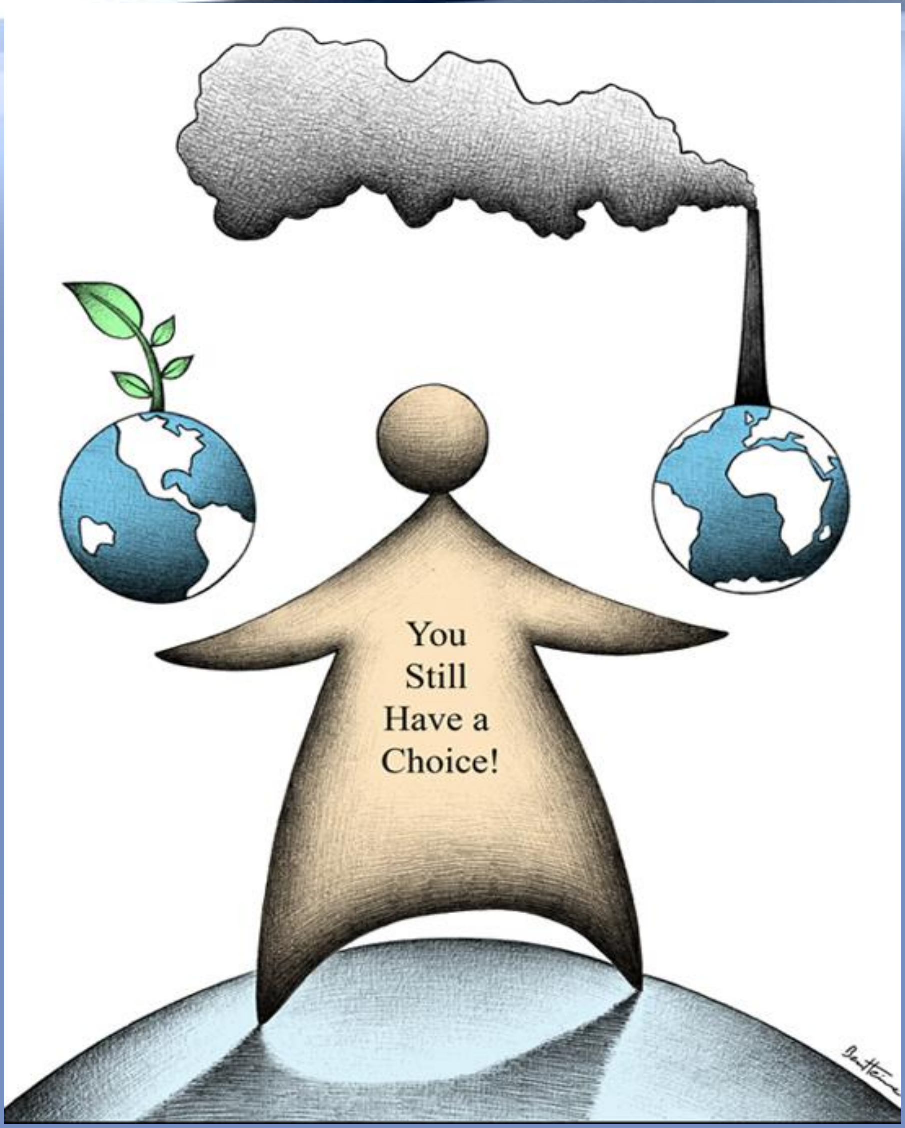
Turn off electronic devices

Simply turning off your television, DVD player, stereo, and computer when you're not using them will save you thousands of pounds of carbon dioxide a year.

Acknowledgements

- Dr. Justin Sanders, President, Alabama Section AAPT
- Dr. David Baah, Chemical Engineering, Tuskegee University
- Physics Faculty, Staff & Students, Tuskegee University
- Electric Vehicle Transportation Center, FSEC/UCF
- Clean Energy Research Center, University of South Florida
- Florida Energy Systems Consortium, University of Florida
- Tuskegee University Energy & Environmental Research Unit

Questions?



Thank you!

Capital cost of Power Technologies

PHOTOVOLTAICS	$5,000 - $10,000/kW
SOLAR THERMAL	$2000 - $3,500/kW
WIND TURBINES	$1,000 - 1,500/kW
COAL THERMAL POWER	$1,200 - 2,000/kW
COMBUSTION TURBINES	$700/kW

Solid State Lighting

Table I: Efficiencies and Efficacies of Various Forms of Commercially Available Lighting in 2007.		
Type of Light Source	Efficiency (%)	Efficacy (lm/W)
Incandescent light bulb	5	15
Long fluorescent tube	25	80
Compact fluorescent lamp (CFL)	20	60
High-power white LEDs	30	100
Low-power white LEDs	50	150
Sodium lamp (high-pressure)	45	130
White LEDs (10-year target)	60	200

Table II: Total Costs of Ownership of a Light Bulb for One Year and Five Years.				
	United States		United Kingdom	
Type of Light Source	1 year	5 years	1 year	5 years
60-W Incandescent	$18	$90	$36	$180
Compact fluorescent lamp (CFL)	$6	$28	$11	$50
60lm/W warm white LED	$18	$36	$23	$58